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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample and a personnel evaluation form are also included. (AG)

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U.S. Training and
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Technical Report
S-312 R

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Development of USTES

APTITUDE TEST BATTERY FOR

SUBSTATION OPERATOR
(light, heat & power)
952.782

SWITCHBOARD OPERATOR
(light, heat, & power)
952.782

TURBINE OPERATOR
(light, heat & power)
952.782

U.S. DEPARTMENT OF LABOR
Manpower Administration

TM 001 958

Technical Report on Development of USTES Aptitude Test Battery

For . . . . .

Substation Operator (light, heat, & power) 952.782-042
Switchboard Operator (light, heat, & power) 952.782-050
Turbine Operator (light, heat, & power) 952.782-062

S-312R

(Developed in Cooperation with the
California State Employment Service

U.S. Department of Labor
Manpower Administration

June 1970

FOREWORD

The United States Training and Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 aptitudes: General Learning Ability, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude, Form Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, with a standard deviation of 20.

Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, in combination, predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

GATB Study #2520

Development of USTES Aptitude Test Battery

For

Substation Operator (light, heat, & power) 952.782-042
Switchboard Operator (light, heat, & power) 952.782-050
Turbine Operator (light, heat, & power) 952.782-062

S-312R

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupations of Substation Operator,(light, heat, & power) 952.782-042, Switchboard Operator (light, heat, & power) 952.782-050, and Turbine Operator (light, heat, & power) 952.782-062. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
N - Numerical Aptitude	80
Q - Clerical Perception	90
M -Manual Dexterity	70

Research Summary

Sample:

102 male workers who interchangeably perform the jobs of Substation Operator, Switchboard Operator, and Turbine Operator, at the Los Angeles City Department of Water and Power, Los Angeles, California.

This study was conducted prior to the requirement of providing minority group information. Therefore minority group composition is unknown.

Criterion:

Supervisory ratings.

Design:

Concurrent (test and criterion data were collected at approximately the same time).

Minimum aptitude requirements were determined on the basis of a job analysis and statistical analyses of aptitude mean scores, aptitude-criterion correlations and selective efficiencies.

Concurrent Validity:

Phi coefficient = .37 ($P/2 < .0005$)

Effectiveness of Norms

Only 68% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 79% would have been good workers. Thirty-two percent of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the above norms, only 21% would have been poor workers. The effectiveness of the norms is shown graphically in Table 1.

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Workers	68%	79%
Poor Workers	32%	21%

Sample Description

Size:

N = 102

Occupational Status:

Employed Workers

Work Setting:

Workers were employed by the Los Angeles City Department of Water and Power, Los Angeles, California.

Employer Selection Requirements:

Education: High school diploma or equivalency as established by GED test.

Previous Experience: None required

Tests: Los Angeles City Civil Service Examination. A minimum score of 70 is required to pass.

Other: 18 years old

Principal Activities:

The job duties for each worker are comparable to those shown in the job description in the Appendix.

Minimum Experience:

All workers in the final sample had at least two months experience.

TABLE 2

Means, Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with Criterion (r) for Age, Education and Experience

	Mean	SD	Range	r
Age (years)	45.8	10.4	24- 64	-.055
Education (years)	12.4	1.5	8- 17	.129
Experience (months)	151.1	100.8	22-384	.216*

*Significant at the .05 level

Experimental Test Battery

All 12 tests of the GATB, B-1002B, were administered during November 1963.

Criterion

The criterion data consisted of two sets of independent ratings made by first-line supervisors. The same supervisor who prepared the first rating completed the second rating, with a time interval of two weeks between the two ratings.

Rating Scale:

An adaptation of USTES Form SP-21 "Descriptive Rating Scale" was was used. The scale (see appendix) consists of eight items covering difference aspects of job performance, with 5 alternatives for each item as to the different degrees of job proficiency.

Reliability

A reliability coefficient of .89 was obtained for the criterion. Therefore, the two sets of ratings were combined.

Criterion Score Distribution:

Possible Range:	16-80
Actual Range:	38-76
Mean:	57.6
Standard Deviation:	13.8

Criterion Dichotomy:

The criterion distribution was dichotomized into low and high groups by placing 32% of the sample in the low group to correspond with the percentage of workers considered unsatisfactory or marginal. Workers in the high criterion group were designated as "good workers" and those in the low group as "poor workers". The criterion critical score is 54.

Aptitudes Considered for Inclusion in the Norms

Aptitudes were selected for tryout in the norms on the basis of a qualitative analysis of job duties involved and statistical analyses of test and criterion data. Aptitude Q which does not have a significant correlation with the criterion was considered for inclusion in the trial norms because the qualitative analyses indicated that this aptitude was important for the job duties and the sample had a relatively low standard deviation on the aptitude. Tables 3, 4, and 5 show the result of the qualitative and statistical analyses.

TABLE 3

Qualitative Analysis
(Based on the job analysis, the aptitudes indicated appear to be important to the work performance)

Aptitudes	Rationale
G - General Learning Ability	Required to learn procedures involving switching operations, approving and inspecting clearance orders or O.K.'s to work, and carrying out orders received from load dispatcher; to perform inspections of station equipment, circuit components, and circuits, and to understand the purpose of inspections made. Also required to exercise independent judgment in the application of safety regulations pertaining to switching operations for clearance orders or O.K.'s to work.
V - Verbal Aptitude	Required to understand the instructions set forth in station instruction bulletins; to enter concise and meaningful information in station log, and to be able to understand comments made by other operators; to communicate intelligently with other operators, load dispatchers, and individuals responsible for repair, maintenance, or construction work.
Q - Clerical Perception	Required to read meters and other recording or indicating devices and to record readings obtained on daily operating records.
M - Manual Dexterity	Required to turn switch knobs in accordance with planned switching sequence established to de-energize equipment, circuit components, and circuits; to open or close manually-operated breaker switches; to make adjustments on transformer and circuit breaker relay switches; to manipulate controls on remote-control panel boards; and to grease turbine fittings with high pressure grease gun.

TABLE 4

Means, Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB; N = 102

	Mean	SD	Range	r
G - General Learning Ability	111.5	13.6	74-147	.215*
V - Verbal Aptitude	109.4	13.3	81-158	.010
N - Numerical Aptitude	103.9	12.1	70-132	.229*
S - Spatial Aptitude	110.5	17.0	76-147	.220*
P - Form Perception	94.4	17.7	62-141	.127
Q - Clerical Perception	100.3	13.9	73-148	.018
K - Motor Coordination	100.0	16.8	54-146	.056
F - Finger Dexterity	84.4	17.6	48-136	.184
M - Manual Dexterity	96.2	20.3	50-140	.210*

*Signficant at the .05 level

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data: Important	X	X				X			X
Irrelevant									
Relatively High Mean	X	X		X					
Relatively Low Standard Dev.	X	X	X			X			
Significant Correlation with Criterion	X		X	X					X
Aptitudes to be Considered for Trial Norms	G	V	N	S		Q			M

Derivation and Validity of Norms

Final norms were derived on the basis of the degree to which trial norms consisting of various combinations of aptitudes, G, V, N, S, Q, and M at trial cutting scores were able to differentiate bewween the 68% of the sample considered to be good workers and the 32% of the sample considered to be poor workers. Trial cutting scores at five-point intervals approximately one standard deviation below the mean are tried because this will eliminate about one-third of the sample with three-aptitude norms. For four-aptitude trial norms, cutting scores of slightly less than one standard deviation below the mean will eliminate about one-third of the sample; for two-aptitude trial norms, minimum cutting scores of slightly more than one standard deviation below the mean will eliminate about one-third of the sample. The Phi Coefficient was used as a basis for comparing trial norms. Norms of N-80, Q-90, and M-70 provided optimum differentiation for the occupations of Substation Operator (light, heat & power) 952.782-042, Switchboard Operator (light, heat, & power) 952.782-050, and Turbine Operator (light, heat, & power) 952.782-062. The validity of these norms is shown in Table 6 and is indicated by a Phi Coefficient of .37 (statistically significant at the .0005 level).

TABLE 6

Validity of Test Norms
N-80, Q-90 and M-70

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	10	59	69
Poor Workers	17	16	33
Total	27	75	102

Phi coefficient = .37 Chi square (X^2_y) = 13.9
Significance level = $P/2 < .0005$

Determination of Occupational Aptitude Pattern

The data for this study met the requirements for incorporating the occupation studied into OAP-11 which is shown in the 1970 edition of Section II of the Manual for the General Aptitude Test Battery. A phi coefficient of .19 is obtained with the OAP-11 norms of G-100, V-90, and Q-90.

SP-21
Rev. 2/61

DESCRIPTIVE RATING SCALE
(For Aptitude Test Development Studies)

Score_____

Rating Scale for _____
D.O.T. Title and Code

Directions: Please read Form SP-20, "Suggestions to Raters" and then fill in the items listed below. In making your ratings, only one box should be checked for each question.

Name of worker (print) _____
(Last) (First)

Sex: Male____ Female____

Company Job Title: _____

How often do you see this worker in a work situation?

☐ See him at work all the time.

☐ See him at work several times a day.

☐ See him at work several times a week.

☐ Seldom see him in work situation.

How long have you worked with him?

☐ Under one month.

☐ One to two months.

☐ Three to five months.

☐ Six months or more.

A. How much work can he accomplish? (Operator's ability to organize job duties and make efficient use of his time.)

( ) 1. Capable of poor work output. Can perform only at a very slow rate.

( ) 2. Capable of fair work output. Can perform only at a slow rate.

( ) 3. Capable of good work output. Can perform at a fast rate.

( ) 4. Capable of high work output. Can perform at a very fast rate.

( ) 5. Capable of extremely high work output. Can perform at an unusually fast rate.

B. How accurate is he in his work? (Operator's ability to read meters and other indicating devices on control board and record readings which vary from normal. His ability to maintain accurate station logs.)

( ) 1. Makes many errors. Work needs constant checking.

( ) 2. Makes frequent errors. Work needs more checking than is desirable.

( ) 3. Makes errors occasionally. Work needs only normal checking.

( ) 4. Makes few errors. Work seldom needs checking.

( ) 5. Rarely makes an error. Work almost never needs checking.

C. How much does he know about his job? (Operator's understanding of the principles, equipment, and methods of operation that are involved directly or indirectly with his work.)

( ) 1. Has very limited knowledge. Does not know enough to do adequate work.

( ) 2. Has limited knowledge. Knows enough to "get by".

( ) 3. Has moderate knowledge. Knows enough to do fair work.

( ) 4. Has broad knowledge. Knows enough to do good work.

( ) 5. Has complete knowledge. Knows his work thoroughly.

D. How quickly did he learn the job duties and new tasks or operations? (Operator's ability to learn rapidly the work he has to do.)

( ) 1. Learned very slowly. Needed careful and repeated instructions.

( ) 2. Somewhat slower than most operators in learning the job and in grasping new phases of the work.

( ) 3. Learned most things about his job in the usual amount of time.

( ) 4. Learned job duties more quickly than most operators.

( ). 5. Learned rapidly. Needed only the minimum amount of instructions for even the difficult job duties.

E. How much aptitude or facility does he have for this kind of work? (Operator's adeptndss or capacity for performing his job easily and well.)

( ) 1. Has great difficulty doing his job. Not suited to this kind of work.

( ) 2. Has some difficulty doing his job. Is minimally suited to this kind of work.

( ) 3. Does his job without too much difficulty. Fairly well suited to this kind of work.

( ) 4. Usually does his job without difficulty. Well suited to this kind of work.

( ) 5. Does his job with great ease. Exceptionally well suited for this kind of work.

F. How resourceful is he when something different or out of the ordinary occurs? (Operator's ability to apply what he already knows to a new situation.)

( ) 1. Very unresourceful. Almost never is able to decide on a course of action without assistance.

( ) 2. Unresourceful. Often has difficulty handling new situations. Needs assistance on all but simple situations.

( ) 3. Fairly resourceful. Sometimes knows what to do, sometimes doesn't. Can deal with situations that are not too complex.

( ) 4. Resourceful. Usually able to handle new situations.

( ) 5. Very resourceful. Practically always resolves what to do when confronted with new situations. Rarely needs assistance.

G. How well and accurate does he communicate with others? (Operator's ability to understand and give instructions; to give adequate instructions or reports on abnormal or hazardous conditions; and to give and receive messages via telephone and/or radio.)

( ) 1. Has a good deal more difficulty than most in maintaining clear communication with others.

( ) 2. Has trouble with communication. Sometimes is confused or confuses others.

( ) 3. Satisfactory. Usually gives and takes information fairly accurately.

( ) 4. Better than average. Seldom has any difficulty with communication.

( ) 5. Excels in understanding and making himself understood.

H. Considering all the factors already rated, and only these factors, how satisfactory is his work? (Operator's "all-around" ability to perform his job.)

( ) 1. Unsatisfactory. Performance usually not acceptable. Probably would not be kept in the event of a reduction in force.

( ) 2. Not completely satisfactory. Of limited value to the organization. Performance occasionally not acceptable.

( ) 3. Satisfactory. A fairly proficient worker. Performance generally acceptable.

( ) 4. Good. A valuable operator. Performance usually excellent.

( ) 5. Outstanding. An unusually competent operator. Performance usually superior.

June 1970

S-312R

FACT SHEET

Job Title

Substation Operator (light, heat & power) 952.782-042
Switchboard Operator (light, heat & power) 952.782-050
Turbine Operator (light, heat & power) 952.782-062

Job Summary

Controls equipment in generating, receiving, or distributing station to regulate flow of electrical current from generators, through substation of electric power system, and over distribution lines to consumers.

Work Performed

Confers with operator of previous shift to determine status of circuits, circuit components, and equipment. Observes positions of switching knobs to determine which circuits are energized, and compares readings will illuminated signal lights to verify that current is flowing through circuits in conformance with switch knob settings. Reads indicating meters to ascertain that current is flowing at prescribed loads in closed circuits. Reads station log to detect unusual switching operations or station activities performed by preceding operators.

Walks through station at times specified to inspect circuit components, equipment, lines, and cables. Resets relay switches tripped due to excessive overloads of current. Observes oil level, temperature, pressure, and vacuum gages and meters on equipment such as nitrogen pressure system, transformers, circuit breakers, and turbines to detect variations from readings specified. Turns valve to return nitrogen pressure to specified level. Greases turbine fittings, using grease gun. Operates needle-valve controls to regulate flow of water into turbine. Reads transformer and circuit breaker relay switch counters, and volt, ampere, and milliwatt meters, and records readings and actions taken during inspection in log and daily operating record.

Studies work orders and confers with individual in charge to determine if proposed activities will distrub non-related circuits, circuit components, or equipment. Plans switching sequence required to provide specified disconnects. Rotates switch knob according to planned switching sequence and observes meters and signal lights before and after each switching step to ascertain if energizing is proceeding according to plan. Opens and locks breaker switches involved in work to be performed, and records the time that the switches are disconnected on switch form. Records switching steps taken in station log. Releases work order to individual in charge.

Receives telephone and radio progress reports, concerning repairs, maintenance, and construction from station operators. Records, in respective logs, type and progress of work being performed and details of changes made in circuits, circuit components, or equipment.

Reads work schedule to determine which stations are scheduled for routine inspection. Confers with receiving-station operator to determine where repair, maintenance, or construction work is to be performed, and to secure switching orders for equipment that could not be actuated from remote control panel. Drives truck to selected locations according to priorities established by schedule or emergencies such as switch failures. Turns remote control to local control and inspects equipment to determine cause of malfunction. Adjusts switches and circuit components, and switches control to remote. Signals operator by radio to actuate controls to insure that corrections work. Reads log of previous inspection, switches controls to local, and inspects circuits, circuit components, and equipment to perform routine station inspections. Reads work order to ascertain that work has been cleared. Performs required switching during repair, maintenance, and construction.

Effectiveness of Norms

Only 68% of the non-test-selected workers used for this study were good workers; if the workers had been test-selected with the S-312R norms, 80% would have been good workers. 32% of the non-test-selected workers used for this study were poor workers; if these workers had been test-selected with the S-312F norms, only 20% would have been poor workers.

Applicability of S-312R Norms

The aptitude test battery is applicable to jobs which include a majority of duties described above.

GPO 898.707